CLAIMS

What is claimed is:

1. An apparatus comprising:

a plasma chamber containing a plasma for a plasma-assisted material process upon a substrate;

a shielding plate within said plasma chamber to actively direct ion flux to desired areas of the substrate; and

a supporting structure to support said shielding plate within said chamber.

2. The apparatus of claim 1 wherein the plasma-assisted material process is a plasma-assisted etching process.

3. The apparatus of claim 1 wherein the plasma-assisted material process is a plasma-enhanced chemical vapor deposition process.

4. The apparatus of claim 1 wherein the shielding plate and the supporting structure are composed of a dielectric material.

5. The apparatus of claim 1 wherein the supporting structure further comprises three or more supporting members.

6. The apparatus of claim 1 wherein the shielding plate is solid to suppress ion flux at the center of the substrate.

7. The apparatus of claim 1 wherein the shielding plate has one or more perforations that allow ion flux to pass, such that the ion flux within a localized area of the substrate is fitted to meet the requirements of a desired material process.

8. The apparatus of claim 1 wherein the dimensions of the plate are dependent upon the dimensions of the plasma chamber and the substrate.

9. The apparatus of claim 8 wherein the thickness of the plate is 2-5 mm.

10. The apparatus of claim 1 wherein the distance between a member of said supporting structure and said substrate is greater than the mean free path of a reactive particle.

11. The apparatus of claim 1 wherein the width of a member of said supporting plate is less than the mean free path of a reactive particle.

12. The apparatus of claim 1 wherein the edge of said plate is rounded.

13. The apparatus of claim 1 wherein the plate is circular.

14. The apparatus of claim 1 wherein the plasma-assisted material process is carried out in high-density plasma.

15. A method comprising:

optimizing the dimensions, geometry, and location of a shielding plate to generate a desired ion flux in a plasma-assisted material process conducted in a plasma chamber;

inserting the plate above a substrate in the chamber; and

carrying out the desired material process upon the substrate by the ion flux generated.

16. The method of claim 15 further comprising optimizing the dimensions, geometry, and location of the shielding plate by numerical simulation.

17. The method of claim 16 further comprising performing the optimization process such that a set of numerically simulated plasma potential contour lines are as close to parallel to the plane of a simulated substrate surface as possible.

18. The method of claim 15 further comprising varying localized ion flux across said substrate by perforating said plate.

19. The method of claim 14 further comprising optimizing the uniformity of energy flux across the substrate surface.

20. A method comprising:

actively directing ion flux within a plasma chamber by the insertion of a plate into the chamber; and

regulating ion flux to different areas of the substrate by altering properties of the plate.

21. The method of claim 20 further comprising conducting a plasma-assisted etching process upon the substrate.

22. The method of claim 20 further comprising conducting a plasma-enhanced chemical vapor deposition process upon the substrate.

23. A method comprising:

placing a shielding plate within a plasma chamber to actively direct ion flux, such that the ratio of (neutrons) / (neutrons + ions) bombarding a substrate is regulated.

24. The method of claim 23 further comprising controlling the rates of horizontal and vertical etching upon the substrate.

25. The method of claim 24 further comprising producing cavities in the substrate having the desired critical dimensions by the directed ion flux.

26. The method of claim 25 further comprising customizing the dimensions of each cavity according to the requirements of a plasma-assisted etching process.

27. A method comprising:

actively directing ion flux within a plasma chamber by the insertion of a shielding plate such that the accumulation of etching by-products across the surface of a substrate is regulated.

28. The method of claim 27 further comprising improving etch uniformity across the substrate.

29. The method of claim 27 further comprising:

preventing the non-uniform accumulation of etching by-products at the center of a substrate; and

increasing the etching rate at the center of the substrate.